REMARKS

The present invention relates to a laminate having titanium oxide layers and its production method.

As described in the specification under "Background Art," beginning at page 1, line 6, laminates having metal layers laminated on a transparent substrate such as glass have been widely used for window glass in buildings and automobiles, for example, for purposes of suppressing emission of heat rays and as a shielding material to suppress leakage of electromagnetic waves radiating from an apparatus such as a plasma display. At the same time, a high visible light transmittance and a low visible light reflectance is required, as well as a preferred reflection color tone. For this purpose, it is well known to use a laminate having a layer construction wherein dielectric material layers and metal layers are alternately laminated one on another. A low heat ray emissivity alone can be obtained by making the metal layer thick, but this may cause a decrease in the visible light transmittance and increase in the visible light reflectance, and the wavelength range in which a low reflectance can be obtained in the visible light region tends to be narrow, whereby a preferred reflection color tone may be impaired. The above unfavorable phenomenon that the reflection color tone is impaired can be somewhat diminished by using a high refractive index material such as titanium oxide as the dielectric material layer, or by increasing the number of laminations. However, when using such a laminate with titanium oxide layers, visible light transmittance tends to decrease, and further, the rate of decrease in the visible light transmittance tends to increase together with the increase in the number of laminations. The present invention addresses these problems.

As broadly disclosed, the present invention is a laminate which comprises a substrate, and a titanium oxide layer, a metal layer and a titanium oxide layer laminated alternately in this order on the substrate in (2n +1) layers (wherein n is a positive integer), wherein an

interlayer having a refractive index of less than 2.4 at a wavelength of 550 nm is interposed at at least one interlaminar boundary between the titanium oxide layer and the metal layer.

The present invention seeks to maximize visible ray transmittance. For this, the interface between the titanium oxide layer and the metal layer has significance. As described in the paragraph in the specification bridging pages 8 and 9:

> In a constitution wherein titanium oxide layers and metal layers are alternately laminated, when the number of lamination is increased, the wavelength width in which a low reflectance can be obtained in the visible light region will increase. However, it was confirmed that the tendency of decrease in transmittance becomes significant along with increase in the number of lamination, more than expected from optical interference effect. The present inventors have conducted extensive studies on this phenomenon and as a result, found that the decrease in transmittance occurs at the interface between the titanium oxide layer and the metal layer. This phenomenon is estimated to be light absorption due to surface plasmon excited by light irradiation in the inside of the metal layer, particularly in the vicinity of the interface with the titanium oxide layer, and it is considered that formation of the surface plasmon can be suppressed to reduce the decrease in transmittance by interposing a layer having a refractive index lower than that of the titanium oxide as an interlayer.

Accordingly, it is unnecessary to increase the thickness of the interlayer to be more than required based on cost considerations. Further, by setting the thickness of the interlayer as described above, the reflectance can be lowered, whereby a wavelength range for obtaining low reflectance can be widened.

In addition, Examples 1-131 and Comparative Examples 1-16 in the specification support the patentability of the presently-claimed invention.

The rejections under 35 U.S.C. § 102(b) of Claims 2-3, 5-6, 9 and 11 as anticipated by, and under 35 U.S.C. § 103(a) of Claim 4 as unpatentable over, U.S. 5,143,796 (Sebastiano et al); of Claim 7 over Sebastiano et al in view of U.S. 6,074,732 (Garnier et al); and of Claims 7-8 over Sebastiano et al in view of U.S. 5,723,075 (Hayasaka et al), are respectfully traversed.

Sebastiano et al discloses a glass windshield for motor vehicles having the following sequence of layers: (glass)/TiO_2 or Al_2O_3)/(Al_2O_3 or SiO_2)/(Al or Al/Ag or Ag/Al or Ag)/(Al_2O_3 or SiO_2)/(TiO_2 or Al_2O_3) (Abstract).

Sebastiano et al neither discloses nor suggests the invention of any of the present independent claims. The Examiner relies on Garnier et al and Hayasaka et al for their respective disclosures of particular resin films. However, neither reference remedies the above-discussed deficiencies of Sebastiano et al. Accordingly, it is respectfully requested that these rejections be withdrawn.

The rejections under 35 U.S.C. § 102(b) of Claims 2-4, 6, 9 and 11 as anticipated by, and under 35 U.S.C. § 103(a) of Claims 5-6 and 9 as unpatentable over, U.S. 5,085,926 (Iida et al); of Claim 7 over Iida et al in view of Garnier et al; and of Claims 7-8 over Iida et al in view of Hayasaka et al, are respectfully traversed.[1]

Iida et al disclosed a heat reflecting glass plate with a six-layer coating consisting of, in order: (1) a metal oxide film, (2) a metal nitride or oxynitride film, (3) a metal film of Ti, Zr, Ta, Cr, Ni-Cr or stainless steel to a thickness of 30-150Å, (4) a metal nitride or oxynitride film, (5) a metal oxide film, and (6) a film of an oxide or oxynitride of Si-Al, Si-Ti or a film of aluminum nitride or oxynitride to a thickness greater than 300 Å; the metal for the oxide films (1) and (5) is Ti, Zr, Ta, Sn or Cr, and the metal for the nitride or oxynitride films (2) and (4) is Ti, Zr, Ta, Cr, Ni-Cr or stainless steel; each of the oxide films (1) and (5) is 200-1000 Å in thickness, and each of the nitride or oxynitride films (2) and (4) is 300-200 Å in thickness (column 2, lines 14-38).

Iida et al neither discloses nor suggests the invention of any of the present independent claims. The Examiner relies on Garnier et al and Hayasaka et al for their

[1] Applicants' counsel notes that while Iida et al was cited in a supplementary partial European search report, which was the reason for the filing of the Information Disclosure Statement (IDS) on April 14, 2003, Iida et al was inadvertently not included in the IDS.

respective disclosures of particular resin films. However, neither reference remedies the above-discussed deficiencies of Iida et al. Moreover, while Iida et al discloses that the prior art has employed Ag and Au in laminated glass articles (column 1, lines 6-25 and column 4, lines 15-32), as noted by the Examiner, these metals are conspicuously absent from the list of possible metals disclosed for use in Iida et al's invention. Given Iida et al's awareness of the use of these metals in the prior art, it is telling that they are not included in Iida et al's invention, and indeed, the disclosure as a whole in Iida et al teaches against the use of such prior art metals **in Iida et al's invention**. Even if it did not teach against, at best, the Examiner has made out an "obvious to try" case with regard to Claim 5 prior to the above amendment.

"Obvious to try" has long been held not to constitute obviousness. *In re O'Farrell*, 7 USPQ2d 1673, 1680-81 (Fed. Cir. 1988) (**copy enclosed**). A general incentive does not make obvious a particular result, nor does the existence of techniques by which those efforts can be carried out. *In re Deuel*, 34 USPQ2d 1210, 1216 (Fed. Cir. 1995) (**copy enclosed**).

For all the above reasons, it is respectfully requested that these rejections be withdrawn.

The rejections under 35 U.S.C. § 102(b) of Claims 2-6, 9 and 11 as anticipated by U.S. 5,110,662 (Depauw et al); and under 35 U.S.C. § 103(a) of Claim 7 as unpatentable over Depauw et al in view of Garnier et al; and of Claims 7-8 as unpatentable over Depauw et al in view of Hayasaka et al, are respectfully traversed.

Depauw et al disclose a substrate of glazing material carrying a multi-layer coating which comprises a reflective layer of silver sandwiched between a transparent undercoat and a transparent overcoat, wherein the undercoat comprises at least one layer of a metal oxide selected from tin oxide, titanium dioxide, aluminum oxide, bismuth oxide, and a mixture of two or more thereof, over which is deposited a layer of zinc oxide having a thickness not

greater than 15 nm, and the overcoat comprises a layer of an oxide of a sacrificial metal selected from the group consisting of titanium, aluminum, stainless steel, bismuth, tin and mixtures of two or more thereof, and formed by initial deposition of the sacrificial metal and its conversion to oxide (column 3, lines 20-35).

Depauw et al neither discloses nor suggests the invention of any of the present independent claims. The Examiner relies on Garnier et al and Hayasaka et al for their respective disclosures of particular resin films. However, neither reference remedies the above-discussed deficiencies of Depauw et al. Accordingly, it is respectfully requested that these rejections be withdrawn.

All of the presently pending claims in this application are now believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

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